CAMBRIAN TRILOBITES FROM THE PURLEY SHALES OF WARWICKSHIRE

by J. D. D. SMITH *and* D. E. WHITE

ABSTRACT. Trilobites from the Purley Shales of Warwickshire are described and illustrated, including those from a new locality. It is concluded that the lowest 40 ft. of the Purley Shales belong to the Lower Cambrian, and at least 450 ft. of higher beds are probably of *Paradoxides oelandicus* age (basal Middle Cambrian).

THE Cambrian rocks which crop out between Atherstone and Bedworth, Warwickshire, were subdivided by Lapworth (1898, pp. 338–50) as follows:

Stockingford Shales { Merevale Shales / Oldbury Shales / Purley Shales }

Hartshill Quartzite

Lapworth suggested that the Purley Shales were about 600 ft. thick, and from these Shales he recorded a number of horny brachiopods together with a single trilobite pygidium associated with a few thoracic segments. Of this trilobite he wrote: 'It is probably referable to *Conocoryphe*, and allied to *C. coronata* Barrande, and *C. ex(s)ulans* Linnarsson' (Lapworth, 1898, p. 346).

Pringle (1913, p. 71) and Illing (1913, p. 452) recorded *Callavia sp.* from red calcareous nodules near the base of the Purley Shales and from purple shales 40 ft. above the base, respectively. Illing (1916, p. 436) concluded that at least the lowest 40 ft. of the Purley Shales belong to 'the middle zone of the Lower Cambrian'.

Illing (1916, p. 436) referred to the *Conocoryphe* mentioned by Lapworth and also to 'a head of *Paradoxides*, a very convex type with well-developed though rather small eyes, and faint glabellar furrows corresponding to *P. sjo(e)greni*, which is found in the *P. oelandicus* Zone of Sweden'. Both these trilobites were found loose in a heap of shales by the roadside in Purley Park Lane, one mile south of Atherstone. Illing considered that they came from the Purley Shales at a position about 100 ft. below the base of the Oldbury Shales, and he tentatively equated this horizon with the *P. oelandicus* Stage of Sweden, i.e. the lowest stage of the Middle Cambrian.

No records of other trilobites from the Purley Shales have been published except for a brief note concerning some of the finds described below (Smith, 1962, p. 54).

PRESENT RESEARCH

The trilobites which form the basis of the present paper were collected in 1961 from temporary exposures of the Purley Shales at the site of a new factory on the Camp Hill Industrial Estate, one mile west-north-west of the centre of Nuneaton, Warwickshire. The locality is 1,790 yds. N. 61° E. of the north-east corner of St. Paul's Church,

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Stockingford: (N.G.R. SP/34819219). A specimen of *Paradoxides* was collected by Mr. J. E. Wright of the Geological Survey during an examination of the excavations. Trilobites, horny brachiopods, and sponge spicules were collected by the authors, who made subsequent visits.

The *Paradoxides* was collected from a 2-inch band of pale brown, sandy siltstone exposed in a trench. Other trilobites were collected 67 ft. to the east-south-east in an adjacent trench, from a 2-inch band of similar lithology thought to represent the same horizon. Near this trench, two trilobites were collected in 1962 from loose material also of similar lithology by Mr. A. W. A. Rushton, who first informed the Geological Survey of these excavations. The authors found no other bands of pale brown, sandy siltstone in the exposure. Numerous specimens of *Lingulella* and *Acrotreta* s.l. and sponge spicules of *Protospongia fenestrata* Salter were collected, these being confined to strata immediately overlying the band in which the *Paradoxides* was found.

The excavations exposed a thickness of about 130 ft. of purple shales, and three thin sills, striking at 110° and with a dip varying between 70° and vertical. The trilobite band cropped out 18 ft. below the highest beds seen in the excavations.

It is not possible to establish exactly the stratigraphical position of the present exposure within the succession of the Purley Shales. However, from a consideration of the six inches to one mile Geological Survey maps of the Coventry area, it is estimated that the Purley Shales, with included sills, are at least 900 ft. thick, and that the trilobite-band occurs at least 350 ft. from the base. These estimates are based on the assumption that there are no major unmapped faults or thick sills in the Purley Shales.

Mr. Rushton has since found trilobites at other temporary exposures in the Purley Shales.

The trilobites from the locality on the Camp Hill Industrial Estate have been identified as:

Condylopyge carinata Westergård
? C. regia (Sjögren)
Pleuroctenium cf. *granulatum* (Barrande)
P. sp.
Eodiscid
Paradoxides cf. *sedgwickii* (Hicks)
Bailiella emarginata (Linnarsson)

SYSTEMATIC PALAEONTOLOGY

The classification and morphological terms used are those adopted in Part O (Arthropoda 1) of the *Treatise on Invertebrate Palaeontology*, Moore 1959. The lateral glabellar furrows are numbered from the posterior end forwards, and the pygidial furrows from the anterior end backwards.

The localities of specimens described are given in the explanation of plates. The zonal classification of the Middle Cambrian is indicated on pp. 405–6.

Specimens in the Geological Survey and Museum collections bear the prefix GSM, those in the University of Birmingham collections the prefix BU, and those in the Sedgwick Museum, Cambridge, collections the prefix SM.

Family CONDYLOPYGIDAE Raymond, 1913
Genus CONDYLOPYGE Hawle and Corda, 1847

Condylopyge carinata Westergård

Plate 57, fig. 2

1936 *Condylopyge carinata* Westergård, p. 27, pl. 1, figs. 4–8.

Material. Internal (GSM 102117) and external (GSM 102118) moulds of one pygidial axis.

Description. Pygidial axis convex, outline incompletely preserved. Trace of first pair of furrows at anterior end of axis; second pair short and transverse; third pair transverse, furrows meeting across axis just behind its centre. Median keel prominent in third axial ring, fading out in second ring. Faint, shallow, median furrow (or crack) on posterior part of axis.

Discussion. The pygidial axis agrees with that illustrated for *Condylopyge carinata.* It differs from *C. regia* (Sjögren) in having a median keel rather than a slightly elongate tubercle, and from *C. rex* (Barrande) in that the median keel does not extend into the first ring.

Age. Westergård (1936, p. 27) recorded *C. carinata* from the Zone of *Paradoxides pinus*, *P. oelandicus* Stage.

Condylopyge sp.

Plate 57, figs. 3, 4

Material. Internal (GSM 102119) and external (GSM 102120) moulds of one cephalon; external (GSM 102114) mould of one cephalon.

Description. Cephalon parallel sided, anterior margin rounded. Border narrow, convex. Border furrow broad, shallow. Axial furrow deep, sharp. Glabella convex, consisting of two lobes separated by deep, transverse furrow. Anterior glabellar lobe semicircular in outline, extended postero-laterally. Posterior glabellar lobe subquadrate, longer than broad, narrower than anterior lobe, with slight median ridge towards posterior, and prominent median tubercle at posterior end. Genal region narrow around anterior glabellar lobe, broadens adjacent to posterior lobe. Short, paired, lateral spine extending backwards from genal region, with apex near mid-breadth.

Discussion. The two cephala agree closely with *Condylopyge carinata* and *C. regia*, and are identified as one or other of these species. Westergård (1936, p. 27) has pointed out that it is only in the pygidium that these two species can be differentiated. The cranidium of *C. carinata* and *C. regia* can be distinguished from *C. rex* by the absence of a tubercle just in front of the centre of the posterior glabellar lobe; the specimens described above have no such tubercle.

Age. Westergård (1936, p. 27) recorded *C. carinata* and *C. regia* from the Zones of *Paradoxides pinus* and *P. insularis* respectively, *P. oelandicus* Stage.

Genus PLEUROCTENIUM Hawle and Corda, 1847

Pleuroctenium granulatum (Barrande)

Plate 57, figs. 5–9

1846 *Battus granulatus* Barrande, p. 15.
1847 *Pleuroctenium granulatum* Hawle and Corda, p. 117, pl. 6, fig. 63.
1916 *Agnostus granulatus* Illing, p. 419, pl. 32, figs. 11–13.
1958 *Pleuroctenium granulatum* Šnajdr, p. 56, pl. 58, figs. 5, 7–15.

Material. Internal (GSM 102121, GSM 102123, and SM A53379a) and external (GSM 102122, GSM 102124, and SM A53379b) moulds of three pygidia; GSM 102123–4 with two thoracic segments attached.

Description. Two thoracic segments. Paired lateral tubercles on each axial ring; large median tubercle on posterior axial ring.

Pygidium rounded posteriorly, slightly tapering forwards. Border slightly convex. Paired lateral spines directed backwards, half as long as pygidium. Pleural field slightly broader than border, slightly convex and flat behind axis. Axis strongly convex, contracted at middle, subacuminate posteriorly; three pairs of very short, weak transverse furrows; first and second pairs directed slightly forwards; third pair slightly backwards. Median tubercle at posterior end of each of first three axial rings; first tubercle very small, second and third tubercles prominent; third tubercle slightly elongated and directed backwards and upwards. Large terminal axial piece.

EXPLANATION OF PLATE 57

All specimens were coated with ammonium chloride before photography by Mr. J. D. Thompson, Geological Survey and Museum.

Fig. 1. Eodiscid. Internal mould of pygidium (GSM 102115).

Fig. 2. *Condylopyge carinata* Westergård. Internal mould of pygidial axis (GSM 102117).

Figs. 3, 4. *Condylopyge sp.* 3, Latex cast from external mould of cephalon (GSM 102114). 4, Internal mould of cephalon (GSM 102119).

Figs. 5–9. *Pleuroctenium granulatum* (Barrande). 5, 6, Internal (GSM 102121) and external (GSM 102122) moulds of pygidium. 7, Internal mould of pygidium (SM A53379a). 8, 9, Internal (GSM 102123) and external (GSM 102124) moulds of pygidium with two thoracic segments.

Figs. 10, 11. *Pleuroctenium sp.* Internal (GSM 102125) and external (GSM 102126) moulds of pygidium.

Figs. 12, 13. *Bailiella emarginata* (Linnarsson). 12, Latex cast from external mould of cranidium (GSM 102113). 13, Part of fixigena of same to show surface markings.

Fig. 14. Conocoryphid. Internal mould of pygidium and part of thorax (BU 546a).

Fig. 15. *Callavia?* Internal mould of a left thoracic pleura (GSM 102127).

Locality of figs. 1–13. Purley Shales, at least 350 ft. above base. Camp Hill Industrial Estate, 1,790 yds. at 61° from north-east corner of St. Paul's Church, Stockingford, Warwickshire. N.G.R.—SP/34819219. Middle Cambrian—*Paradoxides oelandicus* Stage.

Locality of fig. 14. Purley Shales, estimated at 100 ft. below top. Found loose, believed to be from Purley Park Lane, 1,210 yds. at 237° from south-west corner of Church, Mancetter. N.G.R.—SP/31029604. Middle Cambrian—*Paradoxides oelandicus* Stage.

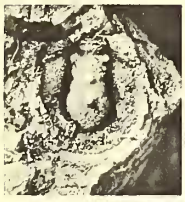
Locality of fig. 15. Purley Shales, calcareous nodules near base. Camp Hill Grange Quarry, 2,450 yds. at ½° from north-east corner of St. Paul's Church, Stockingford. N.G.R.—SP/33349364. Lower Cambrian—? middle part.

1 ×6

2 ×6

3 ×6

4 ×6



5 ×6

6 ×6

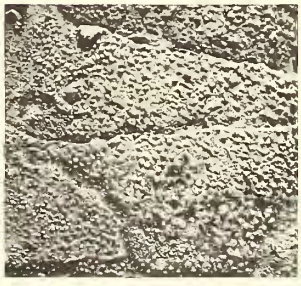
7 ×6

8 ×6

9 ×6

10 ×6

11 ×6



13 ×6

14 ×2

12 ×2

15 ×2

SMITH and WHITE, Cambrian trilobites

Discussion. The three pygidia agree closely with *Pleurocteniium granulatum*. No granulation can be seen, but this is considered to be due to poor preservation.

Age. Pleurocteniium granulatum has not been recorded from Sweden. Šnajdr (1958, p. 59) recorded it from the Skryje Beds of Bohemia, Zone of *Eccaparadoxides pusillus*, which also contain *Condylopyge rex* and so are probably equivalent to the Zone of *Hypagnostus parvifrons* (*Paradoxides paradoxissimus* Stage) of Sweden. Illing (1916, p. 419) recorded *P. granulatum* from his horizons C2–F3 with one specimen from A4, i.e. from the Zone of *Paradoxides aurora* and above.

Pleurocteniium sp.

Plate 57, figs. 10, 11

Material. Internal (GSM 102125) and external (GSM 102126) moulds of one pygidium.

Description. As for *Pleurocteniium granulatum*, but pygidial outline more rounded, pleural field twice width of border, and lateral spines diverge more markedly from border.

Discussion. This specimen is similar in the above respects to *Pleurocteniium tuberculatum* (Illing) (1916, pp. 421–2, pl. 33, figs. 4–8), but differs significantly from that species in having a large terminal axial piece.

Age. In Sweden, the genus *Pleurocteniium* has the same range as *Condylopyge*, i.e. from the lowest zone of the Middle Cambrian to the highest zone of the *Paradoxides paradoxissimus* Stage (Westergård, 1946, p. 35).

Family EODISCIDAE Raymond, 1913

EODISCID

Plate 57, fig. 1

Material. Internal (GSM 102115) and external (GSM 102116) moulds of one incomplete pygidium.

Description. Margin entire. Border narrow, convex. Border furrow deep. Pleural field convex, with three, or perhaps four, furrows. Middle part of axis narrow, convex with two furrows.

Age. The family Eodiscidae is of Lower and Middle Cambrian age. The genus *Eodiscus* is confined to the Middle Cambrian. Westergård (1946, pp. 22–23) recorded one species, *E. oelandicus* (Westergård), from the Zone of *Paradoxides pinus*; this species has four pairs of pygidial furrows, as does *E. sculptus* (Hicks) from the *P. harknessi* Zone of South Wales.

Family OLENELLIDAE Vogdes, 1893

Subfamily CALLAVIINAE Poulsen, 1959

Genus CALLAVIA Matthew, 1897

Callavia?

Plate 57, fig. 15

1913 *Callavia* Pringle, p. 71.

Material. Left-hand part of a thoracic pleura (GSM 102128) and its internal mould (GSM 102127); ten other thoracic fragments.

Description. Pleura gently curved with strong, falcate extremity. Proximal part of pleura deeply grooved, groove dying out less than half-way towards tip.

Discussion. One of Pringle's fossils from that part of the Purley Shales referred to the middle zone of the Lower Cambrian by Illing (1916, p. 436) is illustrated for the first time. Dr. J. W. Cowie has re-examined this specimen first referred to *Callavia* by P. Lake and comments that the fragmentary nature of the material makes a firmer determination than *Callavia?* hazardous. Nevertheless, he accepts a Lower Cambrian age as probable.

Prof. V. C. Illing in a letter has assured the authors that his specimens identified as *Callavia sp.* from the Purley Shales of Worthington Farm (Illing, 1913, p. 452) were no more complete than the fragmentary pleura found by J. Pringle and described above.

Family PARADOXIDIDAE Hawle and Corda, 1847
Subfamily PARADOXIDINAE Hawle and Corda, 1847
Genus PARADOXIDES Brongniart, 1822

Paradoxides cf. *sedgwickii* (Hicks)

Plate 58, figs. 1–8

1871 *Plutonia Sedgwickii* Hicks, p. 399, pl. 15, figs. 1–8.
1935 *Paradoxides sedgwicki* Lake, p. 221, pl. 31, figs. 7–10.

Material. Internal (BU 545a) and external (BU 545b) moulds of one cephalon; internal (GSM 102108) and external (GSM 102109) moulds of one cranidium; internal (SM A53378a) and external (SM A53378b) moulds of part of the thorax comprising eight articulated axial rings of which four have incomplete pleurae attached; internal (GSM 102110) and external (GSM 102111) moulds of one incomplete thoracic segment showing the axial ring and the right pleura.

Description. Cephalon semicircular, slightly pointed anteriorly. Border faintly striated, broad at facial suture, narrowing rapidly towards glabella. Palpebral lobes large, gently curved, convex outwards, touching glabella at its broadest point, extending obliquely backwards to line of first lateral glabellar furrow. Anterior branch of facial suture runs forwards and outwards to margin of cephalon; posterior branch directed backwards

EXPLANATION OF PLATE 58

All specimens were coated with ammonium chloride before photography by Mr. J. D. Thompson, Geological Survey and Museum.

Figs. 1–8. *Paradoxides* cf. *sedgwickii* (Hicks). 1, 2, Internal (GSM 102108) and external (GSM 102109) moulds of cranidium. 3, 4, Internal mould of cephalon (BU 545a), 3 to show impression left by supposed genal spine. 5, Internal mould of one axial ring and pleura (GSM 102110). 6, Internal mould of eight axial rings, four with pleurae attached (SM A53378a). 7, Occipital ring and part of glabella (BU 545a). 8, Occipital ring and part of glabella (GSM 102108).

Fig. 9. *Paradoxides sedgwickii* (Hicks). Occipital ring and part of glabella of syntype (SM A1086), figured by Hicks (1871, pl. 15, fig. 1).

Locality of figs. 1, 2, 5, 6, 8. Purley Shales. As for Plate 57, figs. 1–13.
Locality of figs. 3, 4, 7. Purley Shales. As for Plate 57, fig. 14.
Locality of fig. 9. Solva Beds. Near Nun's Well, St. David's area, Pembrokeshire.

1 ×2

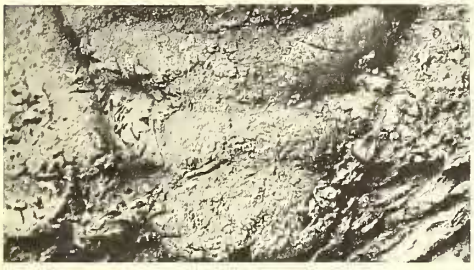
2 ×2

3 ×2

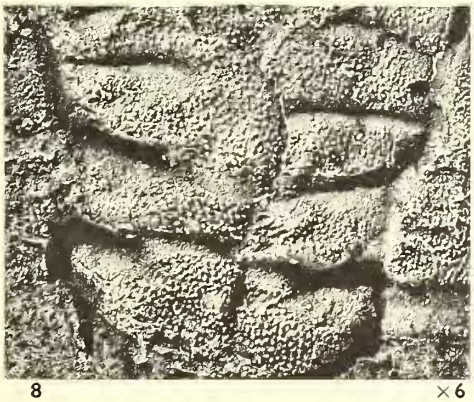
4 ×2

5 ×2

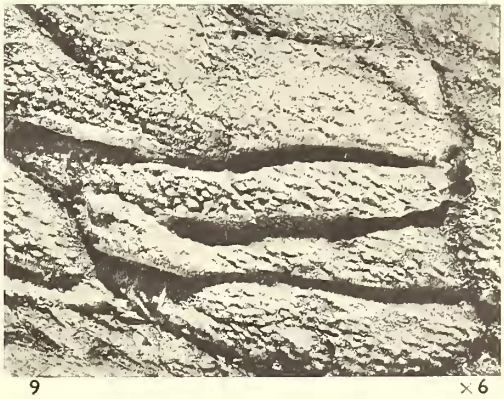
6 ×2



7 ×6



8 ×6



9 ×6

SMITH and WHITE, Cambrian trilobites

and outwards, junction with margin obscure. Axial furrow shallow, deepening posteriorly. Glabella strongly convex in BU 545, crushed flat in GSM 102108, pyriform, tapering posteriorly and slightly pointed anteriorly where it almost meets border. Four pairs of lateral glabellar furrows. First pair directed inwards and slightly backwards, with furrows united across glabella by shallow groove. Second pair directed slightly backwards with furrows united across glabella by very shallow groove in BU 545, transverse with furrows not united in GSM 102108. Third and fourth pairs short, shallow, directed slightly forwards. Fourth pair slightly behind line of maximum breadth of glabella. Occipital ring strongly convex with small median tubercle. Occipital furrow very deep laterally, shallow medially. Cephalon surface covered by close-set granules about 0·1 mm. diameter.

Thoracic pleurae weakly convex, smooth, with prominent pleural furrow. Axis weakly convex, surface bears close-set granules, some united by short ridges. Granules approximately equal in size, rather coarser than on cephalon.

In the matrix of BU 545a there is an impression which may have been caused by a thin, smooth genal spine; the impression, though in a different plane, follows the line of the outer margin of the cephalon but is not, however, continuous with it. It may even be a thoracic pleural spine.

Discussion. Illing (1916, p. 436) compared BU 545 with *Paradoxides sjoegreni*. Dr. M. Lindström, of Lund University, Sweden, has sent the authors examples of this species from Öland, Sweden. BU 545 and GSM 102108 differ from the Swedish specimens in the following features:

1. The glabella tapers backwards much more.
2. The maximum width of the glabella occurs farther back.
3. The granulation is much coarser than in *P. sjoegreni*, only small specimens of which are granulate.
4. The median portion of the second pair of lateral glabellar furrows is not as deep and wide as in *P. sjoegreni*.

Dr. Lindström has examined the *Paradoxides* from the Purley Shales, and in his opinion they do not belong to *P. sjeogreni* or to any other species occurring in Sweden.

The only species of *Paradoxides* with granulation as coarse and prominent as those from the Purley Shales is *P. sedgwickii*. Indeed, the surface markings of this species are so distinctive that Hicks (1871, p. 399) erected a new genus, *Plutonia*, to contain it. Hicks (1871, pl. 15, fig. 1) figured a cephalon of *P. sedgwickii* from the Solva Group of the St. David's area, Pembrokeshire. Examination of this syntype (SM A1086) indicates that the surface markings are similar to those of BU 545 and GSM 102108, although slightly coarser, due in part to distortion. (Compare fig. 9 with figs. 7 and 8 of Plate 58.) In *P. sedgwickii* the lateral glabellar furrows of the second pair are united across the glabella by a deeper groove than BU 545 and the palpebral lobe is relatively smaller than in the two specimens from the Purley Shales.

Hicks (1871, pl. 15, figs. 6–8) also figured parts of the thorax of *P. sedgwickii* illustrating its coarsely granulate axial segments and pleurae. The axial segments of GSM 102110 and SM A53378 have a more coarsely granulate surface than the cranidia GSM 102108 and BU 545, although the pleurae are smooth.